

Innovations in Understanding and Modeling Cryogenic Propellants for Long-Duration Spaceflight

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Research Objectives

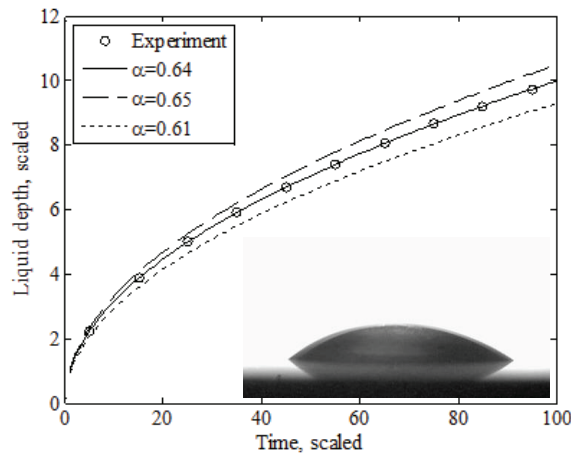
1. determine unambiguously the accommodation coefficients useful for modeling long-duration zero-g cryogenic storage.
2. quantify the influences of the following on accommodation coefficients:
 - a. film thickness,
 - b. interface curvature,
 - c. the presence of a non-condensable gas in the vapor phase.

Approach

Carefully designed experimental apparatus exploiting existing cryogenic infrastructure in Purdue's laboratories creates the necessary new research hardware.

Numerical modeling of the vapor-phase convective flow, as even a very slow is an important non-zero flow, will permit separation of the phase change at the interface and the vapor-phase transport at and near the interface.

This creates the ability to infer zero-gravity accommodation coefficients from one-g experiments.



Example video frame (insert) and anticipated results illustrating the method of altering accommodation coefficient in the model to fit experimental data.

Potential Impact

- Dependable phase-change rate modeling can follow this work.
- Long-term spaceflight cryo storage modeling for both precise and reduced-order modeling.
- Liquid hydrogen data can follow.
- Even long-term 1-g cryo storage, such as for rocket testing and launch, can benefit from improved models.